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Optometric education in America 2001: Moving ahead or losing our way? A comparison of prevalent ocular disorders in the population to curricula in U.S. optometry schools

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Abstract

This project is a survey and comparison of current available epidemiology of ocular conditions within the U.S. population, against the curricula of most optometry schools in the United States. Optometry's role in health care is shifting from primarily functional, lens-based therapies, to fuller scope prescribing privileges and ocular disease management. The endeavor here is to establish whether optometry programs are properly preparing students for careers in optometry, or if the push toward a medical based model is leaving optometrists unprepared to deal with the traditional presentations that bring most patient's to see their optometrist. The comparison of prevalence numbers to correlating emphasis in varying curricula spanned a diverse range, but overall maintained a consistent balance around the population average prevalence numbers. Outlying schools exist at both ends of the spectrum, but balance between the philosophies exists, and the options for students seeking to strengthen their education's toward either a disease model, or toward a functional model, are present throughout the optometric educational system.

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OPTOMETRIC EDUCATION IN AMERICA:2001

MOVING AHEAD OR LOSING OUR WAY?

A COMPARISON OF PREVALENT OCULAR DISORDERS IN THE POPULATION TO CURRICULA IN U.S. OPTOMETRY SCHOOLS

By
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and
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About the Authors

Lara McKnight is a native of both western Oregon and Nevada. She graduated from Willamette University in Salem, Oregon in 1994 with a Bachelor of Science degree in Studio Art. Lara worked in various fields for four years post baccalaureate, but a strong interest in the health sciences brought her ultimately to optometry. She has strong family ties in the Pacific Northwest, and plans to practice optometry in Nevada after graduation.

Janna Jackson is a native of Seattle, Washington. After graduating from Stanford University in 1993 with a Bachelor of Science in Biological Sciences, she spent five years working in the biotechnology industry. Her love of science and a desire for a career devoted to serving others led her to optometry. Janna and her new husband, Robert Greenwell, will reside in the Pacific Northwest.

ABSTRACT

This project is a survey and comparison of current available epidemiology of ocular conditions within the U.S. population, against the curricula of most optometry schools in the United States. Optometry's role in health care is shifting from primarily functional, lens-based therapies, to fuller scope prescribing privileges and ocular disease management. The endeavor here is to establish whether optometry programs are properly preparing students for careers in optometry, or if the push toward a medical based model is leaving optometrists unprepared to deal with the traditional presentations that bring most patient's to see their optometrist.

The comparison of prevalence numbers to correlating emphasis in varying curricula spanned a diverse range, but overall maintained a consistent balance around the population average prevalence numbers. Outlying schools exist at both ends of the spectrum, but balance between the philosophies exists, and the options for students seeking to strengthen their education's toward either a disease model, or toward a functional model, are present throughout the optometric educational system.

Acknowledgements

The authors would like to acknowledge the tireless work of Pacific University's Associate Dean of Clinical Programs, Kenneth Eakland, O.D. His work in establishing a web based log for students to record their clinical experiences has made this project possible. We were able to obtain current, relevant epidemiology from not only the Pacific University clinics, but also every clinical site across both the United States and the world being occupied by Pacific students during 2001. We are profoundly grateful.

Introduction

In a time of both rapidly transitioning technology, and changing social theory surrounding the provision of health care, a source of controversy in optometric practice is the role of primary care optometry within the hierarchy of eye care. Optometry by definition would qualify as primary care of ocular disease, but as specialty care of functional disorders and functional vision. Optometrists are the only health care professionals receiving a high level of specialized education in functional vision, learning disability, low vision, rehabilitative vision, and geriatric, pediatric, and developmental vision care. With the expansion of therapeutic and diagnostic pharmaceutical agent legalization, and use by optometrists across North America, has come an increasing need to define the parameters of primary care optometry in opposition to specialized care ophthalmology. In the attempt to educate and prepare modern optometrists for the demand of adequate disease diagnosis and management, opposing viewpoints have arisen regarding the importance of continued emphasis on traditional optometric education. The question before optometry is, therefore, where lies the respective educational importance of each facet of this expanding profession? The authors' theory upon commencement of this study is that optometric education is being pushed strongly toward a medically based model, and away from the traditional mores of optometric training. This study endeavors

to compare the prevalence of ocular disorders in a patient population, to the corresponding level of education that optometry students currently receive in those areas. The question to be answered is whether the proper emphasis is being placed where future optometrists need it most.

Current curriculum data was gathered from every optometry school in the United States. The curricula were broken down into seven categories, four of which are of particular interest to this study. Functional, Optics, and Refractive classes were combined to compose the 'traditional optometry' category. Disease Management courses were grouped to form the 'disease model' category. Credit hours for each category were added and weighted by percent of total curriculum. The two groupings were turned into a ratio that could be more easily compared to epidemiological data.

Patient data was obtained from the Pacific University database of student activities. This repository of data represents the Pacific University Clinics, external sites across the United States, and sites located abroad that currently house Pacific University interns. Patient data was also grouped by functional vs. disease-oriented primary ocular diagnosis, and a corresponding ratio was calculated for comparison. The ratios generated by each set of data were compared to assess whether optometric education is advancing to better address the needs of patients, or abandoning necessary training that made optometry a uniquely capable niche in eye care.

Dr. Maria VanNurden, O.D. completed a comprehensive ocular epidemiology review in May of 1999, and the figures quoted in her paper, *Epidemiology of the Eye*, will be drawn on for comparison to the clinical data obtained for this study. Her analysis was a broad based literature review, which reflects the most current and accurate epidemiological figures across the population, and the expertise therein is of value to this study.

Methods

Curriculum data was obtained in two ways. Many optometry schools post their curriculum on the university website, leading to easy acquisition. Several schools required formal requests by letter in order to receive this information. Pennsylvania College of Optometry and New England College of Optometry delineate their curricula in a modular form, which explains their class breakdowns in a verbal and non-specific manner. Their data was, therefore, not used for this study. SUNY College of Optometry provided first year curriculum only, which is listed in Table 9. This was not analyzed due to its incompleteness. NOVA and Ohio State University provide full curricula, but specific credit hours are not supplied, making the assignment of relative importance suspect. The data for NOVA and Ohio State is provided in Tables 6 and 7, respectively, to allow the reader to make what comparisons and assumptions he/she chooses. A few

instances of absent credit assignments missing are denoted by credit hours in parentheses. These were rare enough that an average credit assignment of two credit hours was factored into the calculations for these categories.

Epidemiological data was obtained from Dr. Kenneth Eakland, O.D., Associate Dean for Clinical Programs at Pacific University. The University has implemented web-based patient encounter logs on which interns record clinic activity. The software enabling the extraction and collation of this data has recently become available online, and Dr. Eakland shared some of the first reports produced by this system. Dr. Maria VanNurden, O.D., author of *Epidemiology of the Eye*, provides the broader based resource of presumed epidemiology within the population.

Results

Epidemiological results gathered from Pacific students working both within and outside of Pacific University clinics: Summer 2001

External sites

Age Distribution of Clinical Population	Summer 2001	% of Total
0 to 6	720	3.07%
7 to 18	3405	14.54%
19 to 45	7305	31.20%
46 to 60	4950	21.14%
60+	7035	30.04%

Total patients seen	**23,415**	

Pacific University Clinics

Age Distribution of Clinical Population	Summer 2001	% of Total
0 to 6	240	5.10%
7 to 18	1088	23.09%
19 to 45	1620	34.39%
46 to 60	1095	23.25%
60+	668	14.17%
Total patients seen	**4,711**	

Primary Ocular Diagnosis

Diagnosis	External Sites	Pacific U. Clinics
Disorders of the Globe	0.32%	0.48%
Retina defects (include RD)	0.38%	0.64%
Retinopathies (BDR, AMD)	**6.47%**	**4.46%**
Choroidal disorders	0.19%	0.16%
Iris/Ciliary Body disorders	0.51%	1.11%
Glaucoma	**6.34%**	**3.50%**
Cataract	**5.51%**	**3.66%**
Refractive/Accommodative	**64.64%**	**60.99%**
Visual disturbance (VF, CV, Ambly)	**4.10%**	**6.37%**
Blindness, Low Vision	1.67%	0.16%
Keratitis	1.54%	2.07%
Corneal Opacity	1.15%	0.80%
Conjunctival Disorders	1.92%	**5.57%**
Lid inflammation	0.83%	0.80%
Disorders of the Lids	0.58%	0.00%
Lacrimal System Disorders	0.58%	1.11%
Orbital Disorders	0.83%	0.32%

Optic Nerve/Visual Pathway	0.13%	0.64%
Strabismus & Eye movements	1.22%	**6.69%**
Other Disorders of the Eye	1.09%	0.48%

Service Types

	External Sites	Pacific U. Clinics
Primary Care	**64.96%**	**43.95%**
Contact Lens	**8.78%**	**17.04%**
Disease	**11.47%**	**13.38%**
Pediatric	3.07%	**8.44%**
Pre-Op	2.18%	0.00%
Post-Op	3.52%	1.75%
Referral	0.32%	0.80%
Low Vision	0.26%	0.32%
Vision Therapy	4.55%	**13.22%**
Screening	0.13%	0.32%
Other	0.77%	0.80%

Treatment type

	External Sites	Pacific U. Clinics
Spectacle	**31.59%**	**24.15%**
Education	**37.09%**	**36.09%**
Soft Contact Lens	**6.92%**	**8.83%**
Rigid Contact Lens	0.78%	2.26%
Vision Therapy	2.77%	**7.33%**
Over the Counter	2.63%	3.10%
Pharmaceutical Prescription	**5.53%**	**6.67%**
Referral	**4.25%**	2.63%
Low Vision	0.27%	0.19%
Other	8.17%	8.74%

Of note among these statistics is the preponderance of patients above the age of forty-six. Fully fifty percent of the patient population seen at external sites is forty-six and over. The aging baby boom population has been a long anticipated issue in health care. The primary ocular diagnoses bear out the expectation of pathology among an aging population. Primarily we expect the increased prevalence of cataract, glaucoma, dry eye, diabetic and hypertensive retinopathies, and age related macular degeneration. The statistics bear this out, especially at external sites. The higher incidence of functional diagnoses within the Pacific clinics is expected due to the presence of specialty vision therapy, low vision, and pediatric clinics.

Some broader epidemiological numbers derived from Dr. VanNurden's research show a more even distribution between functional/refractive disorders and disease disorders in the population:

Prevalence of Ocular Conditions -All races

Myopia	24.7% both sexes/ all ages
Hyperopia	6.9% at age 6-7
Amblyopia	1.7%-3.85% in school children 22% are strabismic; 6.5% non-strabismic

Strabismus	6.0% in childhood; dramatically increases for mentally retarded children to 21.4%
Convergence Insufficiency	Ranges widely for children and adults 1.0%-32.0%
Accommodative Deficiency	15% in normal teenagers; 85% in teens with reading problems
Chronic Dry Eye	21.0% for 25 and younger; 13.0% for 25-35 year olds; 10.0% for over 45
Blepharitis	2.95% in 18-34 year olds; 3.1% in 55-74 year olds
Keratoconus	0.05-0.23% unspecified across the population
Glaucoma	5 % POAG Positive Dx both eyes, both sexes, all ages (up to 11% in the aged population)
Elevated Intra-Ocular Pressure	20.2% general population fall in the borderline to high 20-30mmHg range
Cataracts	25.6% all ages, nuclear (elevates to 65.5% in pts. over 75) 8.3% all ages, PSC (elevates to 19.7% in pts. over 75)
Diabetic Retinopathy	3.0% all ages, increases to 85-95% in insulin dependent diabetics
Age Related Macular Degen.	2.3% age 45-64; 17-30% at age 75-85

Lattice Degeneration	20% age 20 and below; 31.9% age 21-40; 20.8% for age 41-60
Retinitis Pigmentosa	0.02%-0.033% unspecified
Ocular Toxoplasmosis	0.6% unspecified
Malignant ocular tumors	7.5 per million in NY state (men); 5.4 per million in NY (women)
Retinoblastoma	9.5 per million for boys; 8.7 per million for girls

VanNurden, Maria, O.D., *Epidemiology of the Eye*, May 1999.

The important distinction here is to identify the age group most represented. Functional/refractive patient numbers span a larger portion of the population, while disease states logically focus more on the aging population. Here, the demographics of an individual optometrist's patient population could significantly influence the prevalence of disorders seen.

Cataracts and ARMD are the disease conditions most significant to the aging population from these figures. Both conditions require the screening optometrist to educate and advise the patient. Ultimate treatment, though, is either cataract removal by a surgeon, or possible photocoagulation of a neovascular net in wet ARMD, both performed by an ocular surgeon. The optometrist's role in both cases is that of educating,

monitoring disease progression, and enhancing remaining vision with corrective lenses and low vision devices. The optometrist needs to be well educated on the implications and options facing the patient, but ultimately these disease states will be co-managed.

Based on Pacific University clinic numbers, functional treatment heavily outweighs pharmaceutical prescription dispensing, which is to be expected based on the most common presenting disorders. However, this comparison is further confounded by continued under-utilization of prescribing privileges by optometrists, due to the relatively recent advent of TPA laws. The current status of wide spread prescribing rights among optometrists in the United States, according to the AOA News and a Review of Optometry Online article from November 2000, are as follows:

OD prescriptive authority:

Topicals for anti-allergy: all 50 states and DC

Orals for anti-allergy: 30 states

Topical anti-infectives: all 50 states and DC

Oral anti-infectives: 32 states

Oral anti-infectives (Tetracycline only): 1 state

Topicals for glaucoma: 46 states

Orals for glaucoma: 21 states

Orals for glaucoma (emergency only): 7 states

Topical anti-inflammatories (except steroids): all 50 states and DC

Topical steroids: 47 states

Oral anti-inflammatories (except steroids): 26 states

Oral steroids: 15 states

Oral analgesics (non-narcotic): 35 states

Oral narcotic analgesics: 32 states

Injectables for anaphylaxis: 22 states

Injectables (not just anaphylaxis): 8 states

These numbers illustrate the transitional status of optometric prescribing rights across the United States. In a number of states, optometrists must refer patients with acute ocular diseases that could be managed at the primary level in other areas of the country. Fortunately, optometry schools appear to be educating to the highest possible scope of practice, preparing optometrists to adequately treat disease regardless of that state's DPA and TPA law status.

Tables 1-14, presented at the end of the discussion, delineate the curricula findings from available data at U.S. schools of optometry. The data is broken down into seven categories: Disease Diagnosis and Management, Optics, Basic Science, Refractive Procedures, Functional/ Developmental/ Binocular Vision, Public Health/ Communication/ Other, and Clinic. The intent of this study focused originally on the comparison of the Disease Diagnosis and Management category with the Functional/ Developmental/ Binocular category. It became necessary to combine the Functional, Refractive, and Optics categories in order to make a reasonable comparison. Epidemiological data is broken down by diagnosis code, which groups all binocular, accommodative, and refractive conditions in one large category. The difficulties encountered in categorizing data stem from the inability to assess what topics may

overlap or be included under different course descriptions from school to school. A uniform approach to grouping decisions was attempted throughout. Another concern is the grouping of developmental courses like Pediatrics and Geriatrics within the Functional category. Disease conditions would also be encompassed by these classes. Because the major emphasis is in vision therapy and improved functionality, the placement was deemed appropriate. Clinic credit hours were not calculated into total percentage numbers because there appeared to be a high variability among the schools as to the assignment of clinic credit, and the stage in the educational process when clinic was first introduced. Didactic classes are typically completed by the end of the third year, so fourth year clinical credits were also eliminated from consideration.

Below is a summary of the important conclusions derived from curricula tables. The table presents percentages of curriculum dedicated to disease vs. functional courses, and an approximate ratio of those two percentages.

Table	School	Disease Diagnosis and Management	Functional--Refractive--Optics	Ratio
1	U.C. Berkeley	22.6%	51.3%	1:2.27
2	Illinois CO	26.2%	44.2%	1: 1.69
3	Indiana CO	32.2%	45.9%	1:1.43
4	Michigan CO	25.7%	55.1%	1:2.14
5	UMSL	18.6%	54.9%	1:2.95
6	NOVA	NA	NA	NA
7	Ohio U. CO	NA	NA	NA

8	SCCO	17.6%	58.8%	1:3.34
9	SUNY CO	NA	NA	NA
10	UAB CO	27.6%	47.1%	1:1.71
11	PUCO	18.4%	63.5%	1:3.45
12	U. of Houston	23.3%	58.2%	1:2.50
13	NSUCO	19.7%	56.5%	1:2.87
14	SCO	23.9%	47.7%	1:2.0

In order to accurately compare curricula to epidemiology, prevalence data can also be grouped to give an approximate ratio of importance. The Pacific University external clinic numbers represent the most diverse and large patient population, making it the best resource for calculating a clinical ratio. It is possibly an over-simplification to label each category specifically as "disease", or "functional" courses, but the generalization can be valuable in establishing an overall trend.

Diagnosis	**External Sites**	**Disease or Functional**
Disorders of the Globe	0.32%	Disease
Retina defects (include RD)	0.38%	Disease
Retinopathies (BDR, AMD)	6.47%	Disease
Choroidal disorders	0.19%	Disease

Iris/Ciliary Body disorders	0.51%	Disease
Glaucoma	6.34%	Disease
Cataract	5.51%	Disease
Refractive/Accommodative	64.64%	Functional
Visual disturbance (VF, CV, Ambly)	4.10%	Functional
Blindness, Low Vision	1.67%	Functional
Keratitis	1.54%	Disease
Corneal Opacity	1.15%	Disease
Conjunctival Disorders	1.92%	Disease
Lid inflammation	0.83%	Disease
Disorders of the Lids	0.58%	Disease
Lacrimal System Disorders	0.58%	Disease
Orbital Disorders	0.83%	Disease
Optic Nerve/Visual Pathway	0.13%	Disease
Strabismus & Eye movements	1.22%	Functional
Other Disorders of the Eye	1.09%	NA

From the breakdown of the diagnoses above, 27.28% fall into a disease category, and 71.63% fall into the functional category. This translates into a 1:2.63 ratio, favoring functional conditions.

The following tables, while illustrative of basic percentages, were deemed inappropriate for analysis due to the probability of overlap. For example, the disease condition of keratoconus could be treated with Rigid Contact Lenses, making the categorization of Rigid Contact Lenses as a strictly functional service invalid. Similar discrepancies exist for Treatment Type, so these tables are presented for completeness, rather than analysis.

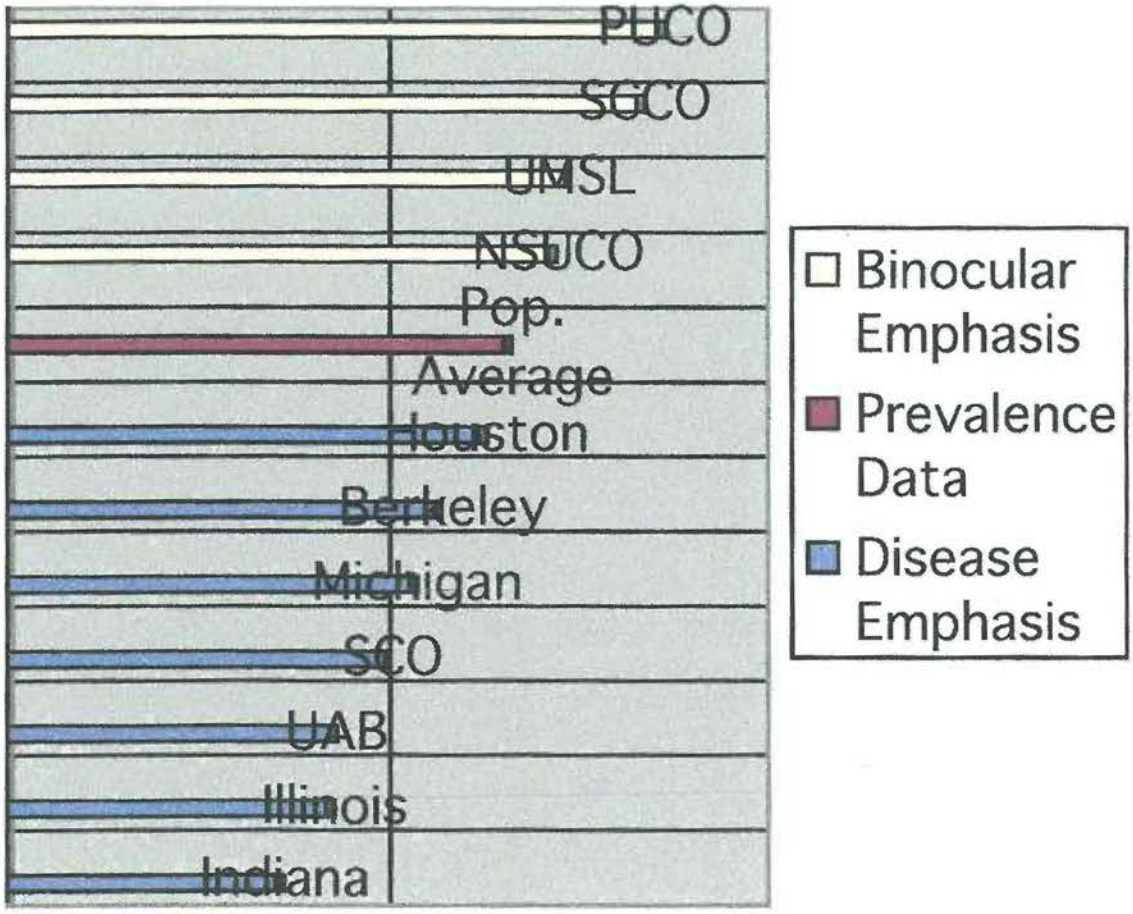
Service Type	**External Sites**	**Disease or**

		Functional
Primary Care	64.96%	Functional
Contact Lens	8.78%	Functional
Disease	11.47%	Disease
Pediatric	3.07%	Functional
Pre-Op	2.18%	Disease
Post-Op	3.52%	Disease
Referral	0.32%	Disease
Low Vision	0.26%	Functional
Vision Therapy	4.55%	Functional
Screening	0.13%	NA
Other	0.77%	NA

Treatment Type	**External Sites**	**Disease or Functional**
Spectacle	31.59%	Functional
Education	37.09%	Functional
Soft Contact Lens	6.92%	Functional
Rigid Contact Lens	0.78%	Functional
Vision Therapy	2.77%	Functional
Over the Counter	2.63%	Disease
Pharmaceutical Prescription	5.53%	Disease
Referral	4.25%	Disease
Low Vision	0.27%	Functional
Other	8.17%	NA

The following table integrates the ratio findings. It shows at a glance where each optometry school analyzed falls in comparison to the national epidemiological average of disease vs. functional ocular disorders. The schools at the top, in white, gear their

curricula more heavily toward functional and refractive topics, while schools below the purple line, in blue, orient their programs more strongly toward disease management topics. A greater number of the schools evaluated do emphasize disease topics at a higher rate. The absence of five schools from this analysis makes it difficult to definitively determine that the trend is moving strongly in that direction.



Discussion

In comparing the ratio from prevalence data (1:2.63 favoring functional ocular conditions) to individual ratios at schools of optometry, it becomes apparent that balance exists across the national curricula. The chart above shows an equitable distribution around the national average, with no significant outliers. No curriculum is perfectly aligned, nor does the blanket categorization of school course titles make this an absolutely accurate depiction of each school's profile. What this does demonstrate is that there is adequate diversity within U.S. Optometry schools, without deviating so far from the population's needs to be considered out of step. Although schools' course offerings have changed over the years to address the educational needs of new optometrists, no one particular school has sacrificed functional vision courses for disease courses. This breakdown of school curricula could feasibly be used as a tool for prospective optometry students who have an idea as to potential areas of specialization. A student more interested in co-management within a large surgical practice may choose a disease-oriented school, while a student interested in vision therapy has the option to apply to a more functional/binocular vision oriented program.

Revisiting these issues in the future would hopefully produce results similar to those found by this study. As states grant more prescribing and disease treatment privileges to optometrists, the profession slowly places more emphasis on medical

treatments. Schools may respond by adding more pharmacology and disease classes to their curricula. Whether or not the profession of optometry abandons its traditional optics-based roots in favor of medicine-based treatment remains to be seen. Although the pendulum has not yet swung in that direction, the potential for such a shift in the future is apparent. It has already happened to some extent, even though the transformation has been a slow one.

Table 1

UC Berkeley						
Disease Diagnosis and Management	**Optics**	**Basic Science**	**Refractive Procedures**	**Functional/ Developmental/ Binocular Vision**	**Public Health/ Communication/ Other**	**Clinic**
Systemic Disease – 5	Optics of Ophthalmic Lenses – 4	Anatomy and Physiology of the Eye – 4.5	Clinical Examination of Visual System B– 2	Eye and Vision in Changing Environment – 2	Freshman/Sopho more Seminar – 2-4	Clinics – 8
Ocular Manifestations of Systemic Disease – 5	Ophthalmic Optics and Environmental Vision – 2	Anat. and Phys of Eye – 4	Clinical Examination of Visual SystemC – 4	Diagnosis and Treatment of Sensorimotor Anomalies – 3	Ethics – 2	Clinic – 9
Diagnosis and Treatment of Ant Seg. Ocular Disease – 4	Contact Lenses A – 3		Clinical Examination of Visual SystemD – 4	Management and Rehab of Sensorimotor Anomalies – 3	Research Project – 1	Advanced Clinic – 6
Diagnosis and Treatment of Post Seg. Disease – 4	Contact Lenses B – 2			Visual Perception and Sensitivity – 4.5	Research Project – 2	Advanced Clinic – 9
Current Concepts in Ocular Disease – 1	Geo Optics – 4			Oculomotor Functions and Neurology – 2	Group Studies – 2	Specialty Clinics – 6

Cell Bio of the Eye and Mechanisms of Ocular Disease – 3	Physical Optics – 4			Binocular Vision and Space Perception – 2	Supervised Independent Study – 1	Specialty Clinics – 7
				Low Vision – 2.5	Freshman/Sophomore Seminar – 2-4	Grand Rounds and Seminar – 2
				Infant Vision – 2	Supervised Independent Study – 1	
Percentage of Curriculum-Clinic not included						
22.6%	19.5%	8.7%	10.3%	21.5%	17.4%	

Table 2

Illinois College of Optometry						
Disease Diagnosis and Management	**Optics**	**Basic Science**	**Refractive Procedures**	**Functional/ Developmental/ Binocular Vision**	**Public Health/ Communication/ Other**	**Clinic**
Human Phys/Path – 3	Geo Optics – 4	Anatomy/ Embryology – 5 credits	Procedures - 1	Sensory Aspects of Vision – 4	Evidence Based Health Care – 1	Patient Care-2
Ocular Disease I-2	Geo Optics – 4	Biochemistry – 4	Opt. 1.1 – 3	Sensory Aspects of Vision II – 5	Opt. Seminar –3.5	Patient Care-6
Ocular Disease II-3	Ophthalmic Optics – 2.5	Histology/Embry ology – 5	Opt. 1.2 – 3	Binocular Vision and Ocular Motility – 5	Evidence Based Health Care-1	Patient Care-6
Ocular Disease III –3	Ophthalmic Optics II - 4.5	Biochemistry II – 4	Opt 2.1 – 4	Color Vision and Developmental Neuro. – 4.5	Health Promotion-1	Patient Care-6
Clinical Medicine-2	Theoretical and Physical Optics-2	Neuroanat./Neuro phys. – 5	Opt 2.2-4	Visual Perception – 2	Communication-2	
Ocular Disease III-3	Contact Lenses I-6	Ocular Phys. – 5		Perspectives on Behavioral	Health Promotion-1	

				Disorders – 1		
Clinical Medicine II-2	Contact Lenses II-1.5	Immunology-1		Strabismus and Amblyopia-4.5	Vision Care of Special Populations-2	
Ocular Disease IV-4		Ocular Anatomy – 6		Binocular Vision Disorders-3.5	Business-2	
General and Ocular Emergencies-1				Low Vision-3		
Neuro-Ophthalmic Disorders-2				Strabismus and Amblyopia II-3		
Physical Diagnosis-2				Vision and Learning-3		
General Pharm. – 3						
General Pharm. II – 3						
Ocular Pharm. and Therapeutics-3						
Physiology/ Pathology – 3						

Ocular Pharm. -3						
Percentage of Curriculum-Clinic not Included						
26.2%	11.5%	21.8%	9.3%	23.4%	7.8%	

Table 3

Indiana						
Disease Diagnosis and Management	**Optics**	**Basic Science**	**Refractive Procedures**	**Functional/ Developmental/ Binocular Vision**	**Public Health/ Communication/ Other**	**Clinic**
Ocular Disease I-3	Geo. Optics I-3.5	Human Gross Anatomy-4	Diagnostic Procedures I-3.5	Neurophysiology of Vision-1	Public Health Policy and the Optometric Profession-2	Clinical Optometry-1
Ocular Disease II-3	Geo. Optics II-3.5	Neuroanatomy-2.5	Diagnostic Procedures II-3.5	Basic Vision Therapy-3	Legal and Professional Aspects of Optometry-2	Clinical Optometry II-2
Principles and Methods of Physical Assessment-3	Ophthalmic Optics I-3	Medical Biochemistry-4	Diagnostic procedures III-2	Low Vision and Rehab-1	Socioeconomic Aspects of Optometry-2	Intro. to Clinic-2.5

Ocular Disease III-2	Physiological Optics I: Visual Optics-3.5	Histology-3		Optometric Gerontology and Geriatrics-1		Clinical Assessment I-2
General Pathology-5	Phys. Optics III:Ocular Motility-2.5	Ocular Anatomy-2		Environmental Optics-1		Optometry Clinic 4
Systemic Physiology-Pharm. I-4	Ophthalmic Optics II-2.5	Ocular Physiology-1.5		Pediatric Optometry-1.5		Clinical Assessment II-1
Systemic Physiology-Pharm. II-5	Contact lenses I-3			Visual Perception and Learning Disability-1.5		Optometric Clinic-4
Ocular Pharm.- 3	Physiological Optics II: Visual Function-2.5					
Ocular Therapeutics-3	Physiological Optics IV: Binocular Function-2.5					
Ocular Microbiology-1						
Ocular Microbiology II-2	Contact Lenses II-3					
Percentage of Curriculum-Clinic not included						
32.2%	27.9%	16.1%	8.5%	9.5%	5.7%	

Table 4

Michigan College of Optometry						
Disease Diagnosis and Management	**Optics**	**Basic Science**	**Refractive Procedures**	**Functional/ Developmental Binocular Vision**	**Public Health/ Communication/ Other**	**Clinic**
Ocular Health Assessment-3	Geometric, Physical, and Visual Optics I-5	Human A & P-5	Assessment of refractive Status and Oculomotor Testing-5	Optical and Motor Aspects of Human Vision-6	The Practice of Optometry-2	Optometry Clinic II-2
Ocular Disease I-4	Geometric, Physical, and Visual Optics II-5	Neuroanatomy-3	Assessment of Oculomotor-Analysis-4	Strabismus and Vision Therapy-4	Public Health Aspects of the Practice of Optometry-3	Optometry Clinic II-1
Ocular Disease II-3	Ophthalmic Optics-3	Ocular Anatomy and Phys.-4		Visual Info. Processing and Perception-6	Ethics and Management of the Practice of Optometry-4	Optometry Clinic III-6
Visual Fields-3	Ophthalmic Optics and Environmental Vision-4			Pediatric Vision-2		Optometry Clinic III-6
Ocular Disease III-2	Contact Lenses I-3			Low Vision and Geriatric Vision-4		Optometry Clinic III-6
General and Ocular Pharm.-5	Contact Lenses II-4			Clinical Neuro-optometry- 2		

General Pathology-4				Developmental Aspects of Vision-3		
Microbiology for Optometry-2						
Pharmacological Management of Ocular Conditions-2						
Percentage of Curriculum-Clinic not included						
25.7%	22.0%	11.0%	8.3%	24.8%	8.3%	

Table 5

University of Missouri						
Disease Diagnosis and Management	**Optics**	**Basic Science**	**Refractive Procedures**	**Functional/ Developmental/ Binocular Vision**	**Public Health/ Communication/ Other**	**Clinic**
Systemic Disease-3	Geometric Optics-4	Neuroanatomy-4	Clinical Optometry-2	Ocular Motility-3	Practice Mgmt.-2	General Clinic-6
Ocular Disease I-4	Physical Optics and Phorometry-2	Human Anatomy & Physiology-6	Clinical Optometry II-5	Monocular Sensory Processes-5	Practice Mgmt.-2	General Clinic-6
Epidemiology-2	Ocular Optics-3	Biochemistry-3	Clinical Optometry III-5	Binocular Vision and Space Perception-4	Ophthalmic Dispensing-1	Pediatric Binocular Specialty Clinic-1
Clinical Medicine-2	Physiological Optics Lab-1	Anatomy & Physiology of the Eye-5	Ocular Assessment-1	Binocular Vision Anomalies-4	Practice Mgmt. III-3	Pediatric/Binocular. Vision Patient Care-3
Ocular Disease II-4	Physical Optics and Phorometry lab-1			Geriatric Optometry-2	Public Health-2	Contact Lens Patient Care-3
General Pharmacology-3	Ophthalmic Optics-4			Environmental Vision-2	Practice Mgmt. IV-2	Co-management Patient Care-1
Ocular Pharmacology-3	Contact Lenses I-3			Low Vision-3		Clinic Seminar-1
	Ophthalmic			Pediatric		Patient Care-7

	Lasers-1			Optometry-3		
	Contact Lenses Specialty Clinic-1					
	Contact Lenses II-3					
Percentage of Curriculum-Clinic not included						
18.6%	20.4%	15.9%	11.5%	23.0%	10.6%	

Table 6

NOVA						
Disease Diagnosis and Management	**Optics**	**Basic Science**	**Refractive Procedures**	**Functional/ Developmental/ Binocular Vision**	**Public Health/ Communication/ Other**	**Clinic**
Ocular Disease I	Geometric Optics	Histology & Embryology	Vision Testing and Technology	Ocular Motility	Public Health I	Primary Care Clinic I
Ocular Disease II	Physical Optics	Gross Anatomy	Optometric Theory and Methods	Psychophysics/Monocular Sensory Processes	Public Health II	Primary Care Clinic II
Ocular Disease III	Visual Optics	General Neuroanatomy	Optometric Theory and Methods II	Intro to Binocular Vision	Public Health III	
Clinical Medicine/Physical Diagnosis	Ophthalmic Optics I	General Physiology	Optometric Theory and Methods III	Anomalies of Binocular Vision I	Public Health IV:Epidemiology	
General Pathology	Ophthalmic Optics II	Anatomy of the Head and Neck	Vision Screening I	Anomalies of Binocular Vision II	Practice Mgmt I	
General Pharmacology I	Contact Lens I	Biochemistry	Optometric Theory and Methods IV	Geriatric Optometry		
General Pharmacology II		Ocular Anatomy	Vision Screening II	Learning Disabilities/ Pediatrics		

Ocular Pharmacology		Visual Neurophysiology				
Microbiology		Ocular Physiology				
		Ocular Physiology				
No credit hours assigned-Data inconclusive						

Table 7

Ohio State University						
Disease Diagnosis and Management	**Optics**	**Basic Science**	**Refractive Procedures**	**Functional/ Developmental/ Binocular Vision**	**Public Health/ Communication/ Other**	**Clinic**
Identification, Mgmt., Tx of Eye Disease I	Geometric Optics	Organ systems Physiology I	Practical Optometry and Patient Care I	Measurement and Specification of Light and Color	Survey of Optometry	Clinical Problems
Identification, Mgmt., Tx of Eye Disease II	Intermediate Geo. Optics	Basic Human Anatomy	Practical Optometry and Patient Care II	Eye Movements	Practice Mgmt. I	Clinical Problems and Conditions II
Primary Eye Care in Neuro. Disease	Physical Optics	Organ Systems Physiology II	Practical Optometry and Patient Care III	Binocular Vision	Practice Mgmt. II	Clinical Problems and Conditions III
Visual Fields	Eye as an Optical Instrument	Microscopic Human Anatomy		Visual Sensory Mechanisms	Practice Mgmt. III	Clinical Problems and Conditions IV
Identification, Mgmt, Tx of Eye Disease III	Ophthalmic Optics I	Ocular Anatomy		Vision of Children	Civic and National Problems in Eye care	
General Pathology	Ophthalmic Optics II	Ocular Physiology: Anterior Segment		Visual Perception	Practice Mgmt IV	
Basic Ocular	Optics of contact	Ocular Physiology II:		Occupational and Environmental	Patient Care: General Care and	

Pharm.	lenses	Posterior Segment		Vision	Ophthalmic Dispensing	
Clinical Ocular Pharm.	Contact Lenses I			Aniseikonia and Low Vision	Patient Care: General Care and Ophthalmic Dispensing	
General Pharmacology	Orthoptics			Optometric Gerontology	Patient Care: General Care and Ophthalmic Dispensing	
	Contact Lenses II					
No credit hours assigned-Data inconclusive						

Table 8

Southern California College of Optometry						
Disease Diagnosis and Management	**Optics**	**Basic Science**	**Refractive Procedures**	**Functional/ Developmental/ Binocular Vision**	**Public Health/ Communication/ Other**	**Clinic**
Clinical Medicine I-3	Optics I - 5	Anatomy and Physiology I - 4	Ocular Refraction-4.5	Visual Psychophysics-(2)	Public Health I - 2	Clinical Service I-1
Clinical Medicine II - 4	Optics II-5	Biochemistry – 2	Case Analysis and Prescribing I – (2)	Sensory Vision-5	Practice Management I-2	Clinical Service II-1
Ocular Disease Diagnosis and Management I - 4	Ophthalmic Optics I-3	Anatomy and Physiology II-4	Ocular Health Procedures I – 4.5	Ocular Motility – 5	Interpersonal Communication-2	Optometric Clinical Service III – 0.5
Ocular Disease Diagnosis and Management II - 4	Optics of the Eye-5	Ocular Anatomy-5	Case Analysis and Prescribing II – (2)	Assessment of Binocular Function – 4.5	Professional Ethics-1	Optometric Clinical Service IV – 3
Ocular Disease Diagnosis and Management III - 3	Ophthalmic Optics II - 3	Neurophysiology-4.5	Ocular Health Procedures II – 3.5	Binocular Vision and Space Perception - 5	Public Health II - 3	Clinical Service V - 3

Table 9

SUNY						
Disease Diagnosis and Management	**Optics**	**Basic Science**	**Refractive Procedures**	**Functional/ Developmental/ Binocular Vision**	**Public Health/ Communication/ Other**	**Clinic**
	Geometric Optics-6	General Histology-4	Optometry I-4.5		Optometric Orientation-1	
	Geometrical Optics II-6	Physiology & Biochemistry I-5.45	Optometry II-4.5		Health Care Organization and Delivery-1.5	
	Physical Optics-3	Gross Human Anatomy I-3	Optometry III-4.5			
	Visual Optics-4	Physiology and Biochemistry II-4.8				
		Neuroscience I-2.5				
		Gross Human Anatomy II-3				
		Physiology & Biochemistry III-2.35				
		Neuroscience II-2.5				

Only first year curriculum available-percentages inconclusive

Table 10

University of Alabama						
Disease	**Optics**	**Basic Science**	**Refractive Procedures**	**Functional/ Developmental/ Binocular Vision**	**Public Health/ Communication/ Other**	**Clinic**
Cornea and External Diseases-4	Geometric Optics-3	Microscopic Anatomy-5	CEVS-5	Visual Psychophysics-3	History, Prof. Regulation and Ethics-1	Primary care Clerkship-1
Diseases of the Posterior Segment-3	Visual Optics-4	Biochemistry of the Eye-3	CEVS-5	Eye Movement mechanisms-2	Clinicolegal Aspects of Optometry-1	Primary Care Clinic-5
Glaucoma-1	Clinical Ophthalmic Optics-3	Ocular Anatomy-2	CEVS-4	Normal binocular Vision-1	Professional/Clinical Communications-1	Primary Care Clinic II-3
Physical Diagnosis-2	Ophthalmic Materials-1	Gross Human Anatomy-4	Clinical management of Vision Problems-2	Visual Perception-3	Epidemiology & Public Health-2	Primary Care Clinic III-3
Medical neuroscience-7	Contact Lenses I-3	Neurobiology of the Visual System-2	Clinical management of Vision Problems-2	Anomalies of Binocular Vision-3	Business Aspects of Optometry-3	Primary Care Clinic IV-3
Systemic Pathology-4	Contact Lenses II-3	Physiology-4		Anomalies of Binocular Vision-		Primary Care Clinic V-3

				3		
General Pathology-3		Physiology of the Eye-3		Neuro-optometry-1		
Microbiology-4				Pediatric, Vision and Learning Disorders-3		
General Pharmacology-3				Environmental Vision/Sports Vision-1		
Ocular Pharmacology-3				Geriatric Optometry-1		
				Low Vision-2		
Percentage of Curriculum-Clinic not included						
27.6%	13.8%	18.7%	14.6%	18.7%	6.5%	

Table 11

Pacific University						
Disease Diagnosis and Management	**Optics**	**Basic Science**	**Refractive Procedures**	**Functional/ Developmental/ Binocular Vision**	**Public Health/ Communication/ Other**	**Clinic**
Diagnostics and Treatment of Ant. Seg. Diseases-3	Geometric Optics-4	Ocular Anatomy & Biochemistry-4.5	Clinical Procedures-3	Behavioral Optometric Science-4	Public health Optometry-2	Patient Care-1
Diagnosis and Mgmt. of Systemic Disease; Pharm. of Syst. Meds.-2	Ophthalmic Optics-3	Functional Neuroanatomy and Neurobiology-3	Theory and methods of Refraction-3	Sensory Motor Interactions in Vision-4	Ophthalmic Dispensing Procedures-2	Patient Care-2
Assessment of Ocular disease-1	Physical Optics-3		Clinical Procedures-2	Physiologic, psych., cognitive changes over the lifespan-2	Thesis planning-1	Patient Care-2
Diagnosis and Mgmt. of Systemic Disease; Pharm. of Syst. Meds.-4	Theory and Practice of Contact Lenses-3	Anatomy of the Visual system-3	Clinical Procedures-2	Visual Optics and Ocular Motility-4	Communication in Optometric Practice-2	
Diagnosis and Treatment of Posterior Segment	Theory and Practice of Specialty Contact Lenses-4		Optometric Case Analysis-4	Visual Info. Processing and Perception-4	Optometric Economics and Practice-4	

Diseases-1						
Diagnosis and Mgmt. of Systemic Disease; Pharm. of Syst. Meds.-2			Clinical Procedures-4	Normal and Abnormal Visual Perception-2		
Assessment and Mgmt. of Ocular Disease Patients-2			Advanced Case Analysis-4	Vision therapy for Binocular and Oculomotor Dysfunction-4		
Applied Ocular Therapeutics-1				Pediatric and Developmental Optometry-2		
Pharmacologic principles and Autonomic agents-3				Assessment and Mgmt of Partially Sighted Patient-2		
Micro, genetics and Immunology/diseases of lid and lacrimal-3				Assessment and Mgmt of Strabismus & Amblyopia-4		
				Eval. and Mgmt. of Patients with Perceptual problems-3		
				Environmental, Occupational and		

				Recreational Vision-2		
Percentage of Curriculum-Clinic not included						
18.4%	14.2%	8.8%	18.4%	30.9%	9.2%	

Table 12

University of Houston						
Disease Diagnosis and Management	**Optics**	**Basic Science**	**Refractive Procedures**	**Functional/ Developmental/ Binocular Vision**	**Public Health/ Communication/ Other**	**Clinic**
General Path and Medicine - 3	Optics I w/lab - 4	Advanced Human Anatomy w/lab - 3	Optometry I - 2	Vision Science I w/lab - 4	Community Health Optometry - 3	General Clinic I - 1
Medical Lab Procedures - 1	Ophthalmic Optics Lab - 1	Advanced Human Physiology - 2	Optometry II - 2	Vision Science II - 2	Practice Management I - 3	General Clinic II - 2
Ocular Pathology I - 2	Optics II w/lab - 4	Human Neuroanatomy and Physiology w/lab - 4	Primary Optometry w/lab - 4	Vision Science III - 2		Optometry Clinic IIIA - 4
Ocular Pathology II - 3	Optics III - 3	Ocular Anatomy and Physiology w/lab - 4		Perception - 2		General Clinic IIIB - 4
Glaucoma - 2	Optics IV - 3			Pediatric Optometry I - 4		Opt III Rounds/Case Discussion - 1
Ocular Pathology	Contact Lens I - 4			Pediatric		General Clinic IIIC - 4

III - 3				Optometry II w/lab - 4		
Ocular Pathology IV - 3	Contact Lens II - 3			Geriatric Optometry - 3		
General Pharm. - 4	Ophthalmic Lasers, Refractive Surgery, and Surgical Techniques w/lab - 4			Rehabilitative Optometry w/lab - 3		
Ocular Pharmacology and Therapeutics - 3				Pediatric Optometry III - 2		
Percent of Curriculum-Clinic not included						
23.3%	25.2%	12.6%	7.8%	25.2%	5.8%	

Table 13

Northeastern State University College of Optometry						
Disease Diagnosis and Management	**Optics**	**Basic Science**	**Refractive Procedures**	**Functional/ Developmental/ Binocular Vision**	**Public Health/ Communication/ Other**	**Clinic**
General Pathology - 3	Geo and Physical Optics - 6	Molecular Biology and Immunology - 3	Intro to Optometry - 1	Vision Science II: Sensory Aspects - 4	Interpersonal Communications - 1	Introduction to Clinic I - 1
Ocular Disease I: Glaucoma, Cataracts, and Anterior Uveal Disease - 3	Vision Science I: Optics - 4	Human Anatomy and Physiology - 7	Optometric Clinical Methods I - 4	Vision Science III: Motility – 4	Optometry in Community Health - 2	Intro to Clinic II - 1
Ocular Disease II: Vitreal, Choroidal, and Retinal Disease - 2	Ophthalmic Optics I - 4	The Human Nervous System - 3	Optometric Clinical Methods II - 3	Pediatrics - 2	Epidemiology - 2	Clinical Practice I - 1
Ocular Disease III: Corneal and External Ocular Disease - 3	Contact Lenses I - 3	Ocular Anatomy and Physiology - 4	Optometric Clinical Methods III - 3	Vision Science IV: Binocular and Perceptual Aspects - 4	Research Methodology - 1	Clinical Practice II - 3
Pathology Seminar I - 1	Ophthalmic			Binocular and Refractive	Practice Development and	Clinical Practice III - 4

	Optics II - 3			Anomalies - 3	Administration I - 3	
Ocular Disease IV: Orbital and Neurological Disease - 2	Contact Lenses II - 3			Environmental Vision - 1	Practice Development and Administration II - 3	Clinical Practice IV - 4
Systemic Therapy in Ocular Disease - 1	Contact Lenses III - 3			Functional Analysis - 1		
Differential Diagnosis of Ocular Disease - 2	Ophthalmic Applications of Lasers - 1			Gerontology - 2		
Pathology Seminar II - 1				Functional Vision Therapy - 4		
General Pharm. - 3				Developmental Vision Therapy - 4		
Ocular Pharm. - 3				Vision Rehabilitation - 2		
Percent of Curriculum—Clinic not included						
19.7%	22.1%	13.9%	9.0%	25.4%	9.8%	

Table 14

Southern College of Optometry						
Disease Diagnosis and Management	**Optics**	**Basic Science**	**Refractive Procedures**	**Functional/ Developmental/ Binocular Vision**	**Public Health/ Communication/ Other**	**Clinic**
Organ System Pathology - 4	Optics of the Eye I - 5	Human Gross Anatomy - 5	Optometric Theory and Methods I - 4.5	Monocular Sensory Processes - 4	Introduction to Optometry - 1	Clinic Orientation I - 1
Diagnosis and Tx of Ant. Seg. Disease I - 4	Optics of the Eye II - 4	Histology - 3	Optometric Theory and Methods II - 4.5	Visual Perception - 5	Ethics and Optometry - 1	Clinic Orientation II - 1
Diagnosis and Tx of Ant. Seg. Disease II - 3	Optics of the Eye III - 4	Biochemistry - 2	Optometric Theory and Methods III - 4.5	Binocular Vision and Ocular Motility - 5	Patient Management - 4.5	Clinical Internship I - 3
Diagnosis and Tx of Post. Seg. Disease I - 4	Ophthalmic Optics - 4	Ocular Anatomy - 5	Optometric Theory and Methods IV - 4.5	Pediatrics - 4	Practice of Optometry I - 3	Clinical Internship II - 3
Diagnosis and Tx of Post. Seg. Disease II - 3	Ophthalmic and Environmental Optics - 4	Human Physiology I - 2.5		Vision Therapy - 4	Public Health and Epidemiology - 2	Clinical Internship III - 5.5

Diagnosis and Tx of Glaucoma - 3	Contact Lenses I - 4	Ocular Physiology - 4		Visual Rehab. - 4	Practice of Optometry II - 3	
Clinical Medicine and Physical Diagnosis - 3	Contact Lenses II - 4	Human Physiology II - 3.5		Strabismus and Amblyopia - 4	Special Topics in Contemporary Eye Care - 1	
Neuro-Eye Disease - 3		Neuroanatomy - 4		Geriatrics - 1	Legal Aspects of Optometry - 2	
General Pathology - 3						
General Pharm. I - 3						
General Pharm. II - 4						
Special Topics in Ocular Pharm. - 2						
Percent of Curriculum—Clinic not included						
23.9%	17.7%	17.7%	11.0%	19.0%	10.7%	

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